Combination, arising from the coexistence of different things, objectively or subjectively, in the same aggregate;

Consistency, arising from the coexistence of different events affirmed by different assertions.

SUCCESSION generates: *Logical inference, Sequence in Space, in Time, and in Action.*

Mixed cases arise from combining assertions of different kinds.

Composition, combination, and consistency only are considered in the present paper. Composition constitutes the primary, and consistency the secondary propositions of Boole. Combination has not been distinctly recognized in logical works, but is constantly implied in Boole's and De Morgan's treatments of Composition, whereby its real character has been overlooked. Logical Inference is partially considered in the treatment of Composition, Combination, and Consistency. Sequence in Space, Time, and Action is not treated at all.

Thomson's, De Morgan's, and Boole's notations are carefully interpreted. Particular attention is paid to Boole's results for Consistency, and the nature of the error which he committed in accommodating those results to Composition, together with the value of his accommodated results, is exactly determined. The ascertainment of these errors by a fundamental reconsideration of the bases of the relations of Composition and Consistency, and a purely logical method of obtaining precise results, forms the distinctive character, as it was the special object, of the present investigation.

II. "On a supposed Periodicity in the elements of Terrestrial Magnetism, with a period of 26$\frac{1}{3}$ days." By GEORGE BIDDELL AIRY, Astronomer Royal. Received March 26, 1872.

In a paper published in the 'Proceedings of the Imperial Academy of Sciences of Vienna,' vol. lxiv., Dr. Karl Hornstein has exhibited the results of a series of observations which appeared to show that the earth's magnetism undergoes a periodical change in successive periods of 26$\frac{1}{3}$ days, which might with great plausibility be referred to the rotation of the sun.

It appeared to me that the deductions from the magnetic observations made at the Royal Observatory of Greenwich, and which are printed annually in the 'Greenwich Observations,' or in the detached copies of 'Results of Magnetical and Meteorological Observations made at the Royal Observatory of Greenwich,' would afford good materials for testing the accuracy of this law, as applicable to a series of years. The mean results of the measured hourly ordinates of the terrestrial magnetic elements are given for every day, and it is certain that there has been no change of adjustments of the declination and horizontal-force instruments in the course of each year. For the horizontal-force instrument the tem-

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perature of the room has been maintained in a generally equable state, and in later years it has been remarkably uniform.

It is easy to see that an error of a single day, or of a large fraction of a day, in the beginning of each period, is of no importance, provided that the errors are not permitted to accumulate. It was allowable, therefore, to take successive periods of 26, 26, 27, 26, 26, 27, &c. days; and in instances when a single day was omitted, or even two days, no sensible error would be introduced by interpolating between the numbers for the days immediately preceding and following the omitted days.

The years selected for this examination were 1850, 1851, 1852, 1868, 1869, 1870; and the beginning of the first period in each year after the first was thus found:—Fourteen periods of $26\frac{1}{3}$ days each amount to $368\frac{2}{3}$ days. For convenience after completion of the annual winter adjustments, the first period in 1850 was made to commence on January 17; therefore the first period in 1851 was commenced on January 21, and that in 1852 on January 25. Similarly, the first periods in 1868, 1869, 1870 commenced on January 1, 4, and 8 respectively; and the beginnings in the three later years are not unconnected with those in the three earlier years: for, from 1852, January 25, to 1868, January 1, are 5820 days, and 221 periods of $26\frac{1}{3}$ days each are $5819\frac{2}{3}$ days; but as the years are widely separated, and a small error of period would produce a large discordance, it has appeared best to exhibit the results of the two three-years' groups separately.

Some periods, in which there were unusually large interruptions, or which were partly occupied with experiments, were omitted entirely. The following is a complete list of periods omitted:—In 1850, that beginning with December 24 for horizontal force; in 1851, that beginning with March 14 or western declination, and those beginning with March 14, June 28, July 24, for horizontal force; in 1852, those beginning with February 20, May 9, December 6, for both elements; in 1868, those beginning with February 23 for declination, and January 1, January 27, February 23, and December 8 for horizontal force; in 1869, those beginning with October 21 and December 12 for both elements; and in 1870, those beginning with June 15 and December 16 for declination, and that beginning with December 16 for horizontal force. Interpolations of three days occur only in the following instances:—1850, (dec.) Feb. 4–6, (h. f.) Feb. 9–11, July 23–25; 1851, (dec.) Feb. 18–20, Oct. 20–22, (h. f.) June 9–11; 1852, (dec.) Feb. 7–9; 1868, (dec.) Feb. 15–17, (h. f.) none; 1869, (dec.) June 6–8, (h. f.) June 6–8; 1870, (dec.) Sept. 24–26, (h. f.) Sept. 24–26.

The mean values of each element for each progressive day in every period of the several years, uncorrected for the proportional part of secular change through the 26 days, and omitting the imperfect 27th day, are as follows:—

	Progressive day of each period.																									
Year.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Declination (omitting 22° in 1850, 1851, 1852; 20° in 1868, 1869; 19° in 1870).																										
1850.	23′·62	22′·91	22′·96	23′·23	23′·05	23′·13	23′·07	23′·00	22′·73	23′·64	23′·39	23′·56	23′·19	22′·83	23′·29	23′·06	22′·75	22′·54	23′·03	23′·15	23′·21	23′·32	23′·24	23′·09	23′·47	23′·17
1851.	17·95	18·25	18·26	18·18	17·92	18·03	17·91	17·90	18·32	18·32	18·48	19·25	19·22	18·79	18·37	18·35	18·38	18·17	18·11	18·45	18·64	18·59	18·36	18·49	18·53	18·63
1852.	17·93	17·88	18·27	17·93	17·47	17·70	17·66	17·36	17·49	17·30	16·86	16·82	16·92	17·16	17·28	16·99	17·59	17·38	17·18	17·11	17·39	17·01	17·23	16·90	16·97	17·20
1868.	13·35	13·16	12·83	13·2	12·90	13·09	13·42	13·27	13·17	12·57	12·47	12·59	12·50	12·84	12·99	12·75	12·75	12·77	12·66	12·67	12·78	13·05	13·11	13·05	12·95	13·34
1869.	5·53	5·34	5·16	5·10	4·88	4·96	4·93	4·40	4·78	4·60	5·02	4·50	4·74	4·78	4·62	4·87	4·53	4·47	4·39	4·84	4·57	4·54	4·59	4·50	4·62	4·69
1870.	53·41	53·28	53·03	53·53	53·13	53·27	54·05	53·62	53·54	53·42	53·21	53·27	53·36	53·22	53·37	53·29	53·18	53·25	52·73	52·98	53·09	52·91	52·78	52·33	52·65	52·51
Horizontal Force (omitting ·11000 in 1850, 1851, 1852, and ·14000 in 1868, 1869, 1870).																										
1850.	310	288	242	269	262	278	259	293	292	280	252	250	208	250	256	245	272	236	234	224	221	251	235	243	236	256
1851.	582	557	545	538	561	544	530	555	530	528	538	565	598	586	568	578	565	553	547	522	530	556	545	539	580	559
1852.	381	357	332	325	348	319	345	350	321	386	404	410	388	353	397	388	412	364	356	357	364	353	352	342	357	373
1868.	283	284	299	307	290	275	265	258	222	265	278	248	249	247	280	305	283	298	303	298	300	298	293	314	321	317
1869.	299	302	284	273	267	270	291	281	295	267	297	287	304	307	284	277	281	313	286	277	273	296	275	243	258	247
1870.	856	853	848	861	888	885	906	930	920	918	941	942	967	955	966	943	938	922	925	905	908	902	882	886	885	892

Taking the means of these numbers separately for the groups of years 1850–1852 and 1868–1870, and applying the proportional parts of secular correction, at the rate of +0′·62 for 26 days in western declination, and at the rate of —·00013 for 26 days in horizontal force, we have the following results:—

Range of years.	Progressive day of each period.																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Western Declination (omitting 22° 10′ in the first range of years, and 20° in the second).																										
1850–1852.	9′·83	9′·70	9′·88	9′·85	9′·58	9′·74	9′·70	9′·59	9′·71	9′·97	9′·83	10′·15	10′·07	9′·91	9′·99	9′·84	9′·96	9′·78	9′·88	10′·04	10′·24	10′·16	10′·15	10′·06	10′·25	10′·29
1868–1870.	4·10	3·95	3·72	3·95	3·74	3·89	4·28	3·93	4·03	3·75	3·82	3·72	3·82	3·93	4·00	4·04	3·88	3·92	3·70	3·97	3·97	4·02	4·03	3·86	4·00	4·13
Horizontal Force (omitting ·11300 in the first range of years, and ·14400 in the second).																										
1850–1852.	124	101	72	75	88	77	75	95	77	93	93	102	92	89	99	96	107	75	69	58	61	76	65	63	78	83
1868–1870.	79	83	76	78	80	74	84	86	75	78	100	86	101	96	102	100	92	102	95	83	83	88	71	69	75	72

The mean for declination in 1870 and, still more remarkably, the mean for horizontal force in 1870 appear to exhibit an increase about the 14th day. But I do not remark in the other means, either as given in numerals or as projected in curves, any thing to support the idea of an inequality periodical in the $26\frac{1}{3}$ days. It might almost be suspected that the secular changes used in the period 1850–1852 are too large; but no alteration of these renders the inequality of $26\frac{1}{3}$ days more probable.

Dr. Hornstein's investigation was limited to observations made in 1870.

Postscript. Received May 9, 1872.

As the diurnal changes of the magnetic elements appear to be due to the action of the sun, it seemed probable that any irregularity in that action depending on the face of the sun presented to the earth might be principally conspicuous in the diurnal change. I therefore thought it prudent to avail myself of the computations of diurnal change of western declination already prepared at the Royal Observatory. The following numbers have been computed in exactly the same manner as those for absolute western declination.

Total diurnal change of western declination.

Year or range of years.	Progressive day of each period.																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1850.	12′·16	13′·01	14′·14	12′·69	11′·29	11′·94	13′·60	10′·32	12′·21	13′·33	11′·89	12′·63	12′·81	12′·84	12′·55	13′·11	13′·06	13′·23	14′·04	14′·13	14′·29	11′·64	12′·46	12′·35	12′·78	14′·29
1851.	11·83	10·58	10·96	11·21	11·45	13·75	10·99	13·14	12·82	12·31	11·23	11·92	12·92	13·15	11·04	13·27	11·62	10·41	11·31	11·77	10·41	11·02	11·54	10·25	11·65	12·19
1852.	12·25	14·95	14·65	14·52	12·08	11·66	13·15	14·35	15·73	12·82	14·16	13·47	13·82	14·43	13·45	15·15	12·43	14·59	14·68	13·27	13·55	13·79	13·18	13·35	13·35	12·73
1850–1852.	} 12·08	12·85	13·25	12·81	11·61	12·45	12·58	12·60	13·59	12·82	12·43	12·67	13·18	13·47	12·35	13·84	12·37	12·74	13·34	13·06	12·75	12·15	12·49	11·88	12·59	13·07
1868.	11·39	10·68	11·89	12·14	11·86	13·45	12·58	12·78	13·95	11·45	13·47	15·36	13·75	11·09	10·05	11·01	10·30	10·62	10·25	10·35	9·70	10·28	11·00	11·02	12·22	11·58
1869.	11·46	11·61	11·55	13·58	12·93	14·49	12·87	13·09	13·30	14·32	13·78	14·03	14·81	14·18	14·03	14·28	13·09	13·93	14·28	14·13	12·68	11·72	12·68	12·42	13·33	12·53
1870.	16·01	14·93	15·24	15·23	13·88	15·19	15·48	16·09	15·31	14·91	14·03	13·70	15·02	14·49	13·07	14·70	14·27	13·48	16·25	15·40	15·99	15·87	16·06	15·12	16·43	15·39
1868–1870.	} 12·95	12·41	12·89	13·65	12·89	14·38	13·64	13·99	14·19	13·56	13·76	14·36	14·53	13·25	12·38	13·33	12·55	12·68	13·59	13·29	12·79	12·62	13·25	12·85	13·99	13·17

In 1870, the diurnal change appears to be less from the 10th to the 18th day than in other parts of the period, but the difference is small. In 1869 it appears to be larger at the same part of the period. In 1868, the small values occur principally towards the end of the period.